TITLE

LEVER STYLE CONSTANT CONTACT SIDE BEARING

CROSS REFERENCE TO RELATED APPLICATION

This application claims priority from United States Provisional Patent Application Serial No. 60/438,223, filed January 6, 2003.

BACKGROUND

A railway freight car is typically composed of a car body supported by centerplates on truck assemblies. The truck assemblies commonly comprise a pair of axle sets supported on a pair of truck bolsters. Side bearing assemblies are usually provided on each side of the centerline of each truck bolster to allow a portion of the car body weight to be transmitted to the truck bolster at a position laterally outboard of the centerplate when the car body leans with respect to the truck due to track irregularities, track cross level, or centrifugal force. Such side bearing assemblies include constant contact side bearings which have a means to effect a supporting load at the side bearing even when the car body is not leaning relative to the truck bolster.

The centerplate connections between the car body and the truck assembly may swivel with respect to the car body either to allow the negotiation of track curves or when the car experiences truck hunting, a destructive harmonic resonance phenomenon. The purpose of a constant contact side bearing is to provide a frictional resistance to truck swivel to inhibit truck hunting. It must do this without unduly degrading the ability of the car to negotiate curves. Normally, a higher constant contact side bearing force produces a more stable condition of the car during travel at high speed. However, if the

force is too high, the increased resistance may inhibit the ability of the truck to swivel easily enough to negotiate curves, resulting in at least unnecessary wheel wear and at worst a disastrous derailment.

The behavior of a constant contact side bearing in controlling truck hunting can be quantified by measuring the area inside a force-displacement hysteresis loop obtained in the following manner: The side bearing is loaded vertically and is caused to cyclically translate horizontally, simulating its action during cyclic truck swivel. The force resisting this movement is plotted against the displacement. One cycle of displacement results in a loop, and the area inside this loop is defined as the hysteresis. A higher value of hysteresis will be more effective in controlling truck hunting.

However, as noted above, the maximum restraint force resisting the truck swivel is a measure of the degradation of the car's ability to negotiate curves. This leads to a desire to provide the greatest hysteresis possible with the smallest maximum force. This occurs when the side bearing resists swiveling with as much force as possible as soon as possible after travel is initiated.

The hysteresis ratio is a commonly used measure of the ability of the side bearing to provide the greatest hysteresis for a given value of restraint at a given cyclic displacement. It is the ratio between the force-displacement hysteresis loop and the maximum hysteresis which could be achieved if the side bearing maintained its maximum force throughout the travel imposed upon it. Graphically, this maximum hysteresis loop is represented by a rectangular shape consisting of two constant force lines and two constant position lines which entirely encloses the hysteresis loop. The numerical value of the hysteresis ratio is obtained by dividing the area of the loop by the

area of the maximum hysteresis loop. The values can range between 0.0 and 1.0, and the larger the number, the more effectively the side bearing is performing.

The design of some types of freight cars leave very little vertical room between the car body bolster and the truck bolster in which to apply a side bearing. Tank cars, for example, may have as little as 2-1/2 in to apply the side bearing. There is an Association of American Railroads requirement that constant contact side bearings be "long travel", i.e. have at least 5/8 inch vertical travel between the normal setup height and the solid height, where additional vertical travel is resisted by a greatly increased force. Long travel designs and low vertical heights at solid condition make it difficult to provide practicable spring designs.

The spring which loads the constant contact side bearing to the proper force at its setup height is frequently an elastomer member. It may be difficult for maintenance personnel to determine whether or not a member of this type is still providing the forces for which it was designed.

In addition, the elastomer members frequently have a temperature dependence which makes their performance variable with ambient temperature. In particular, if an elastomer-type constant contact side bearing is working to limit truck hunting, and is cycled repeatedly at high frequency, the elastomer member may be subject to hysteretic and friction heating which will degrade its performance, and thus provide less effective truck hunting protection.

SUMMARY

According to the invention, a lever style constant contact side bearing assembly can be provided which has a base member with a first joint portion and a lever

member having a second joint portion that cooperates with the first joint portion on the base member to form a translationally restrained and rotationally free joint. The lever member can have a spring reaction portion associated with a spring element that is activated, e.g., compressed, responsive to movement of the spring reaction portion. The lever member can also have upper and lower contact portions adapted to engage, respectively, the base member and a wear plate on a truck bolster or car body. The upper and lower contact portions can be replaceable or have replaceable wear portions, and can be located near the centerline of the truck bolster. In some embodiments, the base member can include a spring mounting portion, and the spring element can be compressed between the spring reaction portion and the spring mounting portion. In other embodiments, a tension member and a spring mounting plate can be employed to associate the spring reaction portion of the lever member with the spring element. In one such embodiment, the tension member can be connected between the spring reaction portion of the lever member and the spring mounting plate, and the spring element can be trapped between the spring mounting plate and a fixed surface, such as part of the car body. Movement of the lever member, and thus the spring reaction portion thereof, places the tension member in tension which thereby compresses the spring element between the spring mounting plate and the fixed surface. In a different embodiment utilizing a tension member, the base member can have a tension member mounting portion and the tension member can be connected between the tension member mounting portion and a spring mounting plate. The spring reaction portion of the lever member can be located intermediate the tension member mounting portion and the spring element can be located in between the spring mounting plate and the spring reaction portion of the

lever member such that movement of the spring reaction portion activates, i.e., compresses, the spring element. In embodiments where a tension member is utilized, an adjusting nut can cooperate with a threaded portion of the tension member whereby the spring element can be preloaded by rotating the adjusting nut.

Other details, objects, and advantages of the invention will become apparent from the following detailed description and the accompanying drawings figures of certain embodiments thereof.

BRIEF DESCRIPTION OF THE DRAWING FIGURES

A more complete understanding of the invention can be obtained by considering the following detailed description in conjunction with the accompanying drawing figures, in which:

FIG. 1 is representative of a force-displacement plot of hysteresis loops of both prior art type constant contact side bearings and an embodiment of a lever style constant contact side bearing according to the invention.

FIG. 2 is a partial sectional elevation view of an embodiment of the invention wherein the base member is attached to a truck bolster and the lever bears on a wear plate attached to a car body bolster.

FIG. 3 is a partial sectional elevation view of another embodiment of the invention wherein the base member is attached to the car body bolster and the lever bears on a wear plate attached to the truck bolster.

FIG. 4 is a partial sectional elevation view of another embodiment of the invention wherein the base member is attached to the car body bolster and the lever bears on a wear plate attached to a truck bolster.

FIG. 5 is a partial sectional elevation view of another embodiment of the invention enabling adjustment of the spring force without jacking the car body from the truck bolster.

FIG. 6 is a partial sectional elevation view of another embodiment in which the spring is held in a well which is received in a hole in the truck bolster.

FIG. 7 is a partial sectional elevation view of another embodiment of the invention wherein the base member is attached to the car body bolster and the lever bears on a wear plate attached to a truck bolster.

DETAILED DESCRIPTION OF CERTAIN EMBODIMENTS

Referring now to the drawing figures, FIG. 1 is a force-displacement plot of hysteresis loops of both prior art type constant contact side bearings and an embodiment of a lever style constant contact side bearing according to the invention. The area of a geometric figure will be noted as $\boldsymbol{A}$, distance will be noted as $\boldsymbol{D}$, and force will be designated as $\boldsymbol{F}$. In addition, any subscripts applied to $\boldsymbol{A}$, $\boldsymbol{D}$, or $\boldsymbol{F}$ will designate the location on the hysteresis diagram at which the area, distance, or force is measured.

In FIG. 1, examples of theoretical force-displacement hysteresis loops show the method in which a hysteresis ratio is calculated. The area of the outer rectangle defined by points ABCDA, represents the maximum hysteresis available with a cycle length of $2{*}\boldsymbol{D}_{\mathrm{J}}$, and a force in each direction (opposing the direction of travel) of $\boldsymbol{F}_{\mathrm{A}}$.

The area of the figure defined by points DFBED is labeled "spring rate" style and represents an hysteresis loop of a prior art side bearing without slack motion but with a spring rate for loading and unloading. The longitudinal spring rate is represented

by the slope of the line between points D and F or between points B and E. The hysteresis ratio would be equal to the area bounded by the geometric figure DFBED divided by the area bounded by the geometric figure DABCD.

The area of the figure defined by points DGHIBJKLD is labeled "gap" style and represents an hysteresis loop of a prior art side bearing without a spring rate for loading and unloading, but with slack represented by the dimension between points G and H or between points J and K, which must be taken up before the force can change direction. This hysteresis ratio would be equal to the area bounded by the geometric figure DGHIBJKLD divided by the area bounded by the geometric figure DABCD.

The area of the figure defined by points DMNOBPQRD is labeled "lever" style, and represents an hysteresis loop of a lever style constant contact side bearing according to the invention, which has slack of the horizontal dimension between points M and N or between points P and Q, and a "spring rate" at the slack of the slope of the line between points M and N or between points P and Q. As noted on the chart, the spring rate is determined by the joint geometry, and the gap is determined by the joint clearance and the geometry of the joint. The force at which the sliding of the joint is initiated is represented by the force G-M or J-P, and is determined by the geometry of the pivot and the force and friction coefficient of the joint, as explained in the next paragraph. The hysteresis ratio would be equal to the area bounded by the geometric figure DMNOBPQRD divided by the area bounded by the geometric figure DABCD.

The force at point M is determined by the friction available in the joint of the lever. The force applied to the trunnion of the lever is determined by the spring force, the lever ratios and the angle at which the joint makes contact with the lever. When the

movement in one direction of the cycle stops, as at point D, and then movement in the other direction impends, the frictional force must perforce drop to zero. If there were no friction at the joint, any slack motion in the joint would then have to be taken up before movement in the other direction could take place, as in the "gap" style loop. However, since there is a force between the trunnion of the lever and the socket of the base, this slack motion cannot be realized until friction at the joint is overcome. Thus no movement can occur until the joint friction force is saturated.

It is clear by inspection, that for the loops shown, a lever style constant contact side bearing according to the invention has a greater hysteresis ratio than the prior art designs. The advantage increases for small displacements which is the case in truck hunting.

Referring now to FIG. 2, there is shown a lever style side bearing assembly 200 which is mounted to a truck bolster 202. This assembly can generally consist of a base member 204 which includes a means for firm attachment, for example by bolts 234, 236, to the truck bolster, a socket 206, and a spring mounting portion 208 adjacent to the truck bolster. A spring element, such as a compression spring 210, can be located in the mounting portion 208, and cooperates with a lever 212 which is next described.

The lever 212 can have at one end a trunnion 214 which fits into the aforesaid socket 206 of the base member 204, forming a translationally restrained, but rotationally free joint 232. Although described as a socket on the base member and a trunnion on the lever, any other type of cooperating portions on the base member and lever which form a translationally restrained and rotationally free joint could be also be

employed. The lever can also have, near the centerline of the truck bolster, an upper contact portion 216 and lower contact portion 218, and at the end opposite the joint 232, a spring reaction portion 220.

The upper contact portion 216 can be biased upward by the spring force and engages the underside of a side bearing wear plate 222 firmly attached to the underside of the car body bolster 224. The upper contact portion 216, which is the contact portion that slidably engages the side bear wear plate 222 in this embodiment, can be made of a particularly durable material, and can also removable, i.e., replaceable. Alternatively, the contact portion 216 may have a replaceable wear portion made from such particularly durable material. A gap 226 occurs between the lower contact portion 218 and the bearing portion 230 of the base member 204. The wear plate may be adjusted by means of shim(s) 228 to allow the appropriate gap 226 for the untilted car body, in a manner well known in the industry.

As the car body leans toward the side of the subject side bearing, the space available for the side bearing is reduced and the vertical gap 226 is reduced in dimension until ultimately it disappears. At this point, the force available to prevent the further leaning of the car body may grow quite large, as it is no longer dependent upon the spring force and the lever ratio.

As the truck swivels, the translation of the side bearing wear plate 222 with respect to the side bearing contact portion 216 results in the maximum value of coulomb friction at the interface with very little movement. The clearance in the joint 232 is the maximum travel which can occur before breaking friction at the contact between upper contact portion 216 and wear plate 222.

FIG. 3 shows a side bearing assembly 300 mounted to a car body bolster 302. This assembly can generally consist of a base member 304 which includes a means for firm attachment to the car body bolster, a socket 306, and a spring mounting portion 308 adjacent to the car body bolster. A spring element, such as a compression spring 310, associated with the end of a lever 312, and in this embodiment, is trapped between the spring mounting portion 308 and the end of the lever 312 and provides the force for loading the side bearing.

The lever 312 can have at one end a trunnion 314 which fits into the aforesaid socket 306 of the base member 304 to form a translationally restrained but rotationally free joint 332. As mentioned previously, besides a pocket on the base member and a trunnion on the lever, any other type of cooperating portions on the base member and lever which form a translationally restrained and rotationally free joint could be also be employed. The lever 312 can also have, near the centerline of the car body bolster, a lower contact portion 316 and an upper contact portion 318, and at the end opposite the joint 332, a spring reaction portion 320.

The lower contact portion 316 can be biased downward by the spring force and engages the upper side of a side bearing wear plate 322 firmly attached to the upper side of the truck bolster 324. The lower contact portion 316, which is the contact portion that slidably engages the side bear wear plate 322 in this embodiment, can be made of a particularly durable material, and can also removable, i.e., replaceable. Alternatively, the contact portion 316 may have a replaceable wear portion made from such particularly durable material. A gap 326 occurs between the upper contact portion 318 and the bearing portion 330 of the base member 304. The wear plate 322 may be adjusted by

means of shim(s) 328 to allow the appropriate gap 326 for the untilted car body, in a manner well known in the industry.

As the car body leans toward the side of the subject side bearing, the space available for the side bearing is reduced and the vertical gap 326 is reduced in dimension until ultimately it disappears. At this point, the force available to prevent the further leaning of the car body may grow quite large, as it is no longer dependent upon the spring force and the lever ratio.

As the truck swivels, the translation of the side bearing wear plate 322 with respect to the side bearing contact portion 316 results in the maximum value of coulomb friction at the interface with very little movement. The clearance in the joint 332 is the maximum travel which can occur before breaking friction at the contact between lower contact portion 316 and wear plate 322.

FIG. 4 shows a side bearing assembly 400 mounted to a car body bolster 402. This assembly can generally consist of a base member 404 which includes a means for firm attachment to the car body bolster and a socket 406.

A spring element, such as a compression spring 410, can be positioned between the car body bolster 402 and a spring mounting plate 462, and can load a lever 412 which is described below. A tension member 460 can be located between a spring reaction portion 420 at one end of the lever 412 and the spring mounting plate 462. The tension member 460 can have an adjustment means so that the compression of the spring element 410 can be adjusted, such as to provide a preload. As shown, for example, the adjustment means can be an adjusting nut 466 cooperating with a threaded portion 464 on the tension member 460.

The lever 412 can be bent in the manner of a bell crank, and can have near the bend a trunnion 414 which cooperates with the socket 406 to form a translationally restrained but rotationally free joint 432. As mentioned previously, besides a pocket on the base member and a trunnion on the lever, any other type of cooperating portions on the base member and lever which form a translationally restrained and rotationally free joint could be also be employed. Upper 418 and lower 416 contact portions can be provided at an end of the lever 412 opposite the spring reaction portion 420, with trunnion 414 being intermediate the two ends. When the spring is compressed, the tension in the tension member 460 loads the lever, and causes lower contact portion 416 to come into contact with side bearing wear plate 422 firmly attached to the upper side of the truck bolster 424. The lower contact portion 416, which is the contact portion that slidably engages the side bear wear plate 422 in this embodiment, can be made of a particularly durable material, and can also removable, i.e., replaceable. Alternatively, the contact portion 416 may have a replaceable wear portion made from such particularly durable material. A gap 426 occurs between the upper contact portion 418 and the bearing portion 430 of the base member 404. The wear plate 422 may be adjusted by means of shim(s) 428 to allow the appropriate gap 426 for the untilted car body, in a manner well known in the industry.

As the car body leans toward the side of the subject side bearing, the space available for the side bearing is reduced and the vertical gap 426 is reduced in dimension until ultimately it disappears. At this point, the force available to prevent the further leaning of the car body may grow quite large, as it is no longer dependent upon the spring force and the lever ratio.

As the truck swivels, the translation of the side bearing wear plate 422 with respect to the lower contact portion 416 results in the maximum value of coulomb friction at the interface with very little movement. The clearance in the joint 432 is the maximum travel which can occur before breaking friction at the contact between lower contact portion 416 and wear plate 422, but due to the direction of the resulting joint force it is possible for no movement to occur, regardless of joint clearance.

FIG. 5 shows a side bearing assembly 500 mounted to a truck bolster 502. This assembly can generally consist of a base member 504 which includes a means for firm attachment to the truck bolster, a socket 506, and a tension member mounting portion 508.

A spring element, such as a compression spring 510, can be positioned on a spring mounting plate 562, and can load a lever 512 which is described below. The spring mounting plate 562 can be supported by a tension member 560 which can be supported by the tension member mounting portion 508 of the base member 504. The tension member 560 can have an adjustment means so that the compression of the spring element 510 can be adjusted, such as to provide a preload. As shown, for example, the adjustment means can be an adjusting nut 566 cooperating with a threaded portion 564 on the tension member 560. .

The lever 512 can have at one end a trunnion 514 which fits into the aforesaid socket 506 of the base member 504 to form a translationally restrained, but rotationally free joint 532. As mentioned previously, besides a pocket on the base member and a trunnion on the lever, any other type of cooperating portions on the base member and lever which form a translationally restrained and rotationally free joint could

be also be employed. The lever can also have, near the centerline of the truck bolster, an upper contact portion 516 and a lower contact portion 518, and at the end opposite the joint 532, a spring reaction portion 520.

The upper contact portion 516 is biased upward by the spring force and engages the underside of a side bearing wear plate 522 firmly attached to the under side of the car body bolster 524. The upper contact portion 516, which is the contact portion that slidably engages the side bear wear plate 522 in this embodiment, can be made of a particularly durable material, and can also removable, i.e., replaceable. Alternatively, the contact portion 516 may have a replaceable wear portion made from such particularly durable material. A gap 526 occurs between the lower contact portion 518 and the bearing portion 530 of the base member 504. The wear plate 522 may be adjusted by means of shim(s) 528 to allow the appropriate gap 526 for the untilted car body, in a manner well known in the industry.

As the car body leans toward the side of the subject side bearing, the space available for the side bearing is reduced and the vertical gap 526 is reduced in dimension until ultimately it disappears. At this point, the force available to prevent the further leaning of the car body may grow quite large, as it is no longer dependent upon the spring force and the lever ratio.

As the truck swivels, the translation of the side bearing wear plate 522 with respect to the side bearing contact portion 516 results in the maximum value of coulomb friction at the interface with very little movement. The clearance in the joint 532 is the maximum travel which can occur before breaking friction at the contact between upper contact portion 516 and wear plate 522.

FIG. 6 shows a side bearing assembly 600 mounted to a truck bolster 602. This assembly can generally consist of a base member 604 which includes a means (not shown) for firm attachment to the truck bolster, a socket 606, and a spring mounting portion 608 which can be positioned in a hole 680 in the top plate of the truck bolster 602. A spring element, such as a compression spring 610, can be located on the spring mounting portion 608, and can load lever 612 which is next described.

The lever 612 can have at one end a trunnion 614 which fits into the aforesaid socket 606 of the base member 604 to form a translationally restrained, but rotationally free joint 632. As mentioned previously, besides a pocket on the base member and a trunnion on the lever, any other type of cooperating portions on the base member and lever which form a translationally restrained and rotationally free joint could be also be employed. The lever can also have, near the centerline of the truck bolster, an upper contact portion 616 and a lower contact portion 618, and at the end opposite the joint 632, a spring reaction portion 620.

The upper contact portion 616 can be biased upward by the spring force and engages the underside of a side bearing wear plate 622 firmly attached to the under side of the car body bolster 624. The upper contact portion 616, which is the contact portion that slidably engages the side bear wear plate 622 in this embodiment, can be made of a particularly durable material, and can also removable, i.e., replaceable. Alternatively, the contact portion 616 may have a replaceable wear portion made from such particularly durable material. A gap 626 occurs between the lower contact portion 618 and the bearing portion 630 of the base member 604. The wear plate 622 may be

adjusted by means of shim(s) 628 to allow the appropriate gap 626 for the untilted car body, in a manner well known in the industry.

As the car body leans toward the side of the subject side bearing, the space available for the side bearing is reduced and the vertical gap 626 is reduced in dimension until ultimately it disappears. At this point, the force available to prevent the further leaning of the car body may grow quite large, as it is no longer dependent upon the spring force and the lever ratio.

As the truck swivels, the translation of the side bearing wear plate 622 with respect to the side bearing contact portion 616 results in the maximum value of coulomb friction at the interface with very little movement. The clearance in the joint 632 is the maximum travel which can occur before breaking friction at the contact between upper contact portion 616 and wear plate 622.

Instead of having the loading elements in line with the force between the truck bolster and the car body bolster, as is common in constant contact side bearing designs today, a lever style constant contact side bearing as described herein can locate the spring element outside the direct path of the force between the truck bolster and body bolster, and employ a lever to apply the force.

FIG. 7 shows a side bearing assembly 700 mounted to a truck bolster 724. This assembly can generally consist of a base member 704 which includes a means for firm attachment to the truck bolster 724, a socket 706, and a spring mounting portion 708.

A spring element, such as a compression spring 710, can be positioned between the spring mounting portion 708 and a spring mounting plate 762, and can load a lever 712, as described below. A tension member 760 can be located between the spring

reaction plate 762 and a spring reaction portion 720 provided at one end of the lever 712. The tension member 760 can have an adjustment means so that the compression of the spring element 710 can be adjusted, such as to provide a preload. As shown, for example, the adjustment means can be an adjusting nut 766 cooperating with a threaded portion 764 on the tension member 760.

The lever 712 can have a trunnion 714 which cooperates with the socket 706 to form a translationally restrained but rotationally free joint 732. As mentioned previously, besides a pocket on the base member 704 and a trunnion 714 on the lever 712, any other type of cooperating portions on the base member 704 and lever 712 which form a translationally restrained and rotationally free joint could be also be employed. At an end of the lever 712, opposite the spring reaction portion 720, there can be provided an upper contact portion 716 and a lower contact portion 718. The trunnion 714 is located intermediate the two ends of the lever 712. When the spring element 710 is compressed, the tension in the tension member 760 loads the lever 712, causing lower contact portion 718 to come into contact with the bearing portion 730 of the base member 704. The upper contact portion 716, which is the contact portion that slidably engages the side bearing wear plate 722 in this embodiment, can be made of a particularly durable material, and can also removable, i.e., replaceable. Alternatively, the upper contact portion 716 may have a replaceable wear portion made from such particularly durable material. A gap 726 occurs between the lower contact portion 718 and the bearing portion 730 of the base member 704. The wear plate 722 may be adjusted by means of shim(s) 728 to allow the appropriate gap 726 for the untilted car body, in a manner well known in the industry.

As the car body leans toward the side of the subject side bearing, the space available for the side bearing is reduced and the vertical gap 726 is reduced in dimension until ultimately it disappears. At this point, the force available to prevent the further leaning of the car body may grow quite large, as it is no longer dependent upon the spring force and the lever ratio.

As the truck swivels, the translation of the side bearing wear plate 722 with respect to the upper contact portion 716 results in the maximum value of coulomb friction at the interface with very little movement. The clearance in the joint 732 is the maximum travel which can occur before breaking friction at the contact between upper contact portion 716 and wear plate 722, but due to the direction of the resulting joint force it is possible for no movement to occur, regardless of joint clearance.

As illustrated by way of example in the drawing figures, the fulcrum for the lever may be located in various ways, and the lengths of the lever arms may be designed so as to allow the placement of the loading elements in a location convenient to the designer. In this way, the entire length of the loading spring does not have to be accommodated within the distance normally available for the side bearing, and small side bearing heights may therefore be accommodated with long travel constant contact side bearings. This can allow the use of longer spring elements, including coil springs whose characteristics do not vary with time and temperature.

By making the lever bent at or near the fulcrum, in the manner of a bell crank, the spring element may be located with the line of action in a different direction than the final force applied to the bolster, if desired.

The contact portion of the side bearing which frictionally engages the side bearing wear plate when the truck swivels may be made of a particularly durable material to extend the useful life of the side bearing. If desired, the contact portion can comprise a removable wear portion so that more expensive members do not require replacement prematurely.

In the lever style constant contact side bearing according to the invention, the spring element can be separated from the point of frictional sliding which can reduce the potential for having the performance of the constant contact side bearing change when subjected to heat input from the sliding friction.

By designing an appropriate lever ratio, the spring force can be provided by helical coil springs of the designs normally used in trucks to support the truck bolster. These types of springs are readily available in most car building shops and car maintenance facilities. If truck springs were used, maintenance personnel could determine visually whether or not the springs were fractured, and if not, the length to which the springs were compressed would imply the force level.

There may also be incorporated into the lever style constant contact side bearing a method to adjust the load applied at the side bearing without removing the car body from the truck, a particularly advantageous feature for the user.

The fulcrum may be made with very little free play, and the lever may be made sufficiently rigid so that the maximum force of frictional sliding is reached with very little horizontal side bearing movement. Consequently, the hysteresis ratio will be quite high. Even if free play is present at the fulcrum, movement cannot occur until the friction force is saturated and sliding begins at the joint. By designing the lever so that

the line of force from the spring element is not in line with the vertical bolster wear plate reaction, for example as shown in FIG. 4, it is possible for essentially no movement to occur at the joint, regardless of clearance.

The fulcrum may be located on a member that is attached to either the truck bolster or the car body bolster, but it can be preferable that it not be located on the bolster upon which the sliding wear member bears continuously. The fulcrum may lie either between the sliding wear member and the loading spring element, as shown in FIGS. 2-3 and 5-6, or at the end of the lever, as shown in FIG. 4. If located at the end of the lever, either the sliding wear member or the spring element may be in the middle of the lever. Some examples of suitable fulcrums are pinned joints or trunnions on the lever which fit into suitable sockets in the mounting member.

A lever style constant contact side bearing as described above can have a very high hysteresis ratio by providing a saturated friction force opposing longitudinal movement as quickly as possible after such longitudinal movement is initiated. The lever style constant contact side bearing can also be easy to apply and maintain, can have long life without appreciable degradation of performance, can be relatively insensitive to temperature variation, and wherein the preload generally will not appreciably degrade with time. According to the invention, a low-profile long travel constant contact side bearing can be provided which can be applied to almost any type of car. A lever style constant contact side bearing according to the invention also can permit easy inspection for force level of the side bearing and can further allow convenient adjustment of the side bearing load without jacking the car body off the truck.

Although certain embodiments of the invention have been described in detail, it will be appreciated by those skilled in the art that various modifications to those details could be developed in light of the overall teaching of the disclosure. Accordingly, the particular embodiments disclosed herein are intended to be illustrative only and not limiting to the scope of the invention which should be awarded the full breadth of the following claims and any and all embodiments thereof.